Exploring the use of Mandala on Anxiety Reduction

A Senior Honors Thesis presented in partial fulfillment of the requirements for graduation

with honors research distinction in Psychology

in the undergraduate colleges of The Ohio State University

by

Victoria R. Bradford

The Ohio State University

April 2020

Project Advisor: Professor Joseph P. Green, Professor, Department of Psychological Sciences

Acknowledgements: I thank Carla Caprella and Michael Green for their help running participants, Rou Rasekhy for assistance with data entry, and Mary Ann Kromer and Katherine Black for their contribution towards designing the study. I especially thank Dr. Green for his help with statistical analyses and editing this report.

Abstract

Previous work suggested that coloring a mandala results in greater reductions in self-reported anxiety than coloring a plaid design or "free coloring" (van der Vennet and Serice, 2012). With an undergraduate student sample (N=121), we examined whether coloring a mandala has a unique effect on reducing anxiety following a 4-minute writing exercise on a past anxiety-filled event. We compared coloring a mandala to tracing a mandala, free coloring, or simulating a waiting room (control condition). We collected anxiety readings at baseline, following the writing exercise, midway and at the end of our 20-minute intervention, and after a 15-minute delay. All interventions produced a reduction in anxiety; however, no one condition was superior to any other. Our findings do not support the claim that coloring a mandala is especially soothing or has unique anxiety-reducing properties. We also briefly assessed attitudes about coloring and how often students colored on a monthly basis.

Anxiety is defined by the American Psychological Association (2013) as an emotion distinguished by the onset of worrying thoughts and feelings of tension. Generalized anxiety disorder is associated with persistent worrying about multiple topics for a minimum of six months, is one of the most commonly diagnosed mental health disorders, and the condition has a high comorbidity rate with depression (Sue, Sue, Sue, & Sue, 2016). Another example of an anxiety disorder is social anxiety disorder which affects about 7% of the US population and is characterized by distressing levels of anxiety that sometimes paralyzes behavior or leads to avoidance of social settings that disrupts routines and interferes with everyday life (National Institute of Mental Health, 2017). An estimated 31.1% of adults in the United States of America will experience an anxiety disorder at some point in their lives, and women are twice as likely as men to be diagnosed with an anxiety disorder between the ages of puberty and 50 (Harvard, 2007). However, only 36.9% of those who are diagnosed with an anxiety disorder will receive treatment (National Institute of Mental Health, 2017). Cognitive behavioral therapy is a highly effective form of treatment and is commonly used alongside anti-depressive medications to treat anxiety disorders (Sue et al., 2016). Due to the high prevalence of anxiety and relative cost of treatment, researchers have sought low cost behavioral activities or mental exercises that could alleviate anxiety without recourse to medication or formal psychotherapy.

The creation of art through coloring, painting, or drawing is a viable option to de-escalate self-reported levels of anxiety and elevate mood (Sandmire, 2012). Several studies suggest that artistic endeavors create a *flow state*, described as a psychological state of optimal attention and engagement that has a relaxing effect (see Chilton, 2013). However, a review of over 700 studies on the therapeutic value of creating art to reduce anxiety reported that, overall, the body of work on art therapy is still limited by a lack of randomly controlled trials and small sample sizes

(Abbing & Ponstein, 2018). Still, there are reasons to believe that art production can have stress-reducing or relaxing effects (Bell & Robbin, 2007, p. 72). For example, Renjendran (2020) recently suggested that coloring "therapeutic" images such as mandalas, building structures, or fictitious creatures had stronger effects on lowering anxiety than drawing with pens on blank sheets of paper. Relatedly, van der Vennet and Serice (2012) found that coloring a mandala produced greater reductions in anxiety compared with coloring a plaid design or "free coloring" on a blank sheet of paper. A mandala is made of geometric combinations of symbols within the design. Jung (1973) suggested that mandalas can be considered an archetype of wholeness, harmony, and balance. Mandala images are used throughout the world and are often associated with unity. Spiritual leaders have used mandalas in a variety of contexts to guide people during meditation or as an aid to trance induction to restore health and promote well-being (Brauen, 2009). van der Vennet and Serice (2012) findings suggest that there may be something uniquely soothing about coloring the mandala design. They concluded, "The results provide evidence that the act of coloring as well as the focus on the mandala design can be useful to reduce anxiety" (p. 83).

Curry and Kasser (2005) explored the possible benefit of coloring a mandala image to reduce anxiety among undergraduate students. They randomly assigned students to either color a mandala picture, color a plaid design, or engage in "free color" on a blank piece of paper. Each coloring condition lasted for 20 minutes. Sample size within each condition ranged from 27 to 30 students. Before the coloring exercise, students were instructed to think about a past event where they felt "most fearful" and then to write out details of that event for a period of four minutes (p. 82). Students' anxiety level was assessed via the State Anxiety Inventory (SAI; Speilberger, 1983) at three times points: at the beginning of the study, after writing about a

fearful event, and following the coloring exercise. Curry and Kasser reported that students who colored the mandala or the plaid figure experienced greater anxiety reduction than those in the free color condition. Moreover, they found that students who colored the mandala or the plaid figure reported lower average anxiety ratings than they did at baseline.

In an attempt to replicate the work of Curry and Kasser's (2005), van der Vennet and Serice (2012) tested the effect of coloring on self-reported anxiety levels using a similar design. Students wrote about a past fearful scenario and then colored either a mandala image, a plaid figure, or engaged in free coloring. The authors used the same plaid design and mandala as used by Curry and Kasser. van der Vennet and Serice recruited both undergraduate and graduate student participants and each group of students colored for 20 minutes at a time. Students completed the coloring in a group format, mimicking a classroom experience. Similar to Curry and Kasser's design, the groups were run different times. The authors found that coloring the mandala produced the greatest reduction in anxiety, relative to the other conditions. Furthermore, only the mandala coloring resulted in a statistically significant reduction in anxiety compared to baseline.

A potential limitation in van der Vennet and Serice's (2012) design is that they ran participants in groups (ranging in size of 13 to 22), allowing students to potentially interact with one another during the study. It is unclear from their published report how far apart participants were seated, whether they engaged in conversation while coloring, or if they shared art supplies such as colored pencils. Social interaction while students colored might influence the experience of anxiety. Some participants might welcome social interaction as a coping mechanism to anxious or uncomfortable experiences whereas others might find it intimidating, if, for example, they begin to compare their coloring ability to others. Previous work has also been limited by

relying exclusively on self-report to assess anxiety. Self-report measures are not always reliable and can be affected by demand characteristics, participant expectations, and personal inaccuracy when describing internal states (Weidman, Steckler, & Tracey, 2017). Building upon previous work, we designed a study to examine the effectiveness of coloring a mandala image on anxiety. Similar to past designs (Curry & Kasser, 2005; van der Vennet & Serice, 2012), we attempted to induce anxiety by having participants write for four minutes about a past event that was anxiety producing. Then, we randomly assigned participants to one of the four conditions, each lasting for 20 minutes: coloring a mandala; tracing a mandala; free coloring; or a waiting (control) condition designed to simulate a waiting room experience.

Our study design extends the work of Curry and Kassser (2005) and van der Vennet and Serice (2012) in a number of ways. First, we added a couple of novel conditions (i.e., tracing the mandala and a waiting room condition). We included a tracing condition as a comparison to coloring the mandala. Perhaps, activities involving the mandala, as opposed to specifically coloring it, are beneficial to relaxation. Our design allowed for a comparison between coloring the mandala and tracing it to see if either action or both reduces anxiety. To our knowledge, no one has explored whether coloring versus tracing the mandala is superior at reducing anxiety. Unlike Curry and Kasser (2015) and van der Vennet and Serice (2012), we included a control condition (waiting room) to explore how anxiety levels might change across time. Similar to past work, we included a free color condition to assess whether coloring in and of itself is effective in reducing anxiety.

Second, we ran participants in individual sessions in an attempt to avoid the possible confounding negative or positive effects of social interaction on anxiety when in a group setting. Third, unlike van der Vennet and Serice (2012) and Curry and Kasser's (2005) work, we

included heart rate as a physiological measure of anxiety. Heartrate has been used as a physiological indicator of state anxiety in other studies (DeLue, 1999; Kantor, 2001). Heart rate may be influenced by awareness of signals from the body or the perception (regardless of accuracy) of bodily changes. Commonly, people's heart rate can increase simply from having it taken in a clinical setting or by focusing their attention on pulse rate (Spruill, 2007). In an attempt to discourage students from focusing on their heart rate number, we did not allow them to see their heart rate measurement and we did not give feedback about their heart rate.

Fourth, we assessed anxiety across five time points during our investigation, including mid-way through our 20-minute intervention and after a 15-minute delay at the end of our study. By contrast, van der Vennet and Serice (2012) assessed anxiety at three time points (baseline, post-anxiety inducing exercise, and after coloring). Adding assessments midway through the intervention and after a brief delay enabled us to examine how soon into the coloring or tracing activity does anxiety reduction occur (e.g., 10 vs. 20 minutes) and whether any positive effect persists beyond the end of the activity (i.e., 15-minutes after stopping coloring/tracing). Whereas Curry and Kasser (2005) and van der Vennet and Serice (2012) administered a 20-item self-report anxiety inventory (i.e., SAI) to assess anxiety at multiple time points, we assessed *momentary anxiety* by means of a single question asking participants to rate their current level of anxiety on a scale of zero to ten. Our choice of using a single item versus a longer inventory was practical given that we had five assessment time points. We thought that completing a 20-item survey at five different times within the hour would become tiresome and repetitive. In addition, we wanted to capture momentary anxiety and concerned that anxiety might dissipate over the time required to complete a longer inventory.

In sum, our study set out to address the following questions: (a) Is anxiety reduction specific to coloring a mandala or would, perhaps, tracing a mandala produce the same effect as coloring a mandala? (b) Does coloring or tracing a mandala reduce anxiety to a greater extent than "free coloring" on a blank sheet of paper? (c) Does anxiety reduction stem from active engagement in *any* of our three coloring or tracing activities or might it result from the mere passage of time? (d) Will 10 minutes be sufficient or will the full 20 minutes be necessary to observe a reduction in anxiety? and, (e) Does any benefit in anxiety-reduction end immediately after the coloring or tracing activity stops or might the effect linger for a little while after the activity ends?

At the beginning of the study, participants completed two brief measures of anxiety and personality. We expect to show that participants within our conditions had similar anxiety levels and personality characteristics before we began our study. Towards the end of our study, we administered a brief survey of attitudes towards coloring and tracing to capture participants' beliefs about how effective coloring is at reducing anxiety and whether participants regularly color. We asked if they used coloring as a relaxation technique when stressed, and, if so, how often did they do so in a month's time.

Finally, because we ran students in individual sessions over the course of three semesters, it was possible for students that already participated to discuss the study with other prospective participants, and that some might figure out the purpose of the study. To ensure that participants' pre-conceptions of what the experimenter was looking for did not interfere with their responses, we asked participants to write out what they believed to be the purpose of the study. Given our design, we assumed that several, if not most, would conclude that the study's purpose was to examine anxiety across multiple time points, and, for those in the coloring or

tracing conditions, that these activities might reduce anxiety. We determined in advance that if participants specifically mentioned the mandala or referenced it in some manner as being our focus for reducing anxiety, then we would eliminate them and their responses from the data set.

Method

Materials

Demographic questions. We collected demographic information for all students including age, sex, class rank (e.g. freshman, or sophomore), and race.

Assessment of Color Blindness. We asked participants if they were colorblind. In addition, we administered three tests of color blindness based on the Ishihara colorblind assessment test (Ishihara, 1972). The stimuli consisted of three plates that contained a circle of multicolored dots that form a number (see in Figure 1). Students were asked to correctly identify the three numbers shown within the dotted pattern.[1]

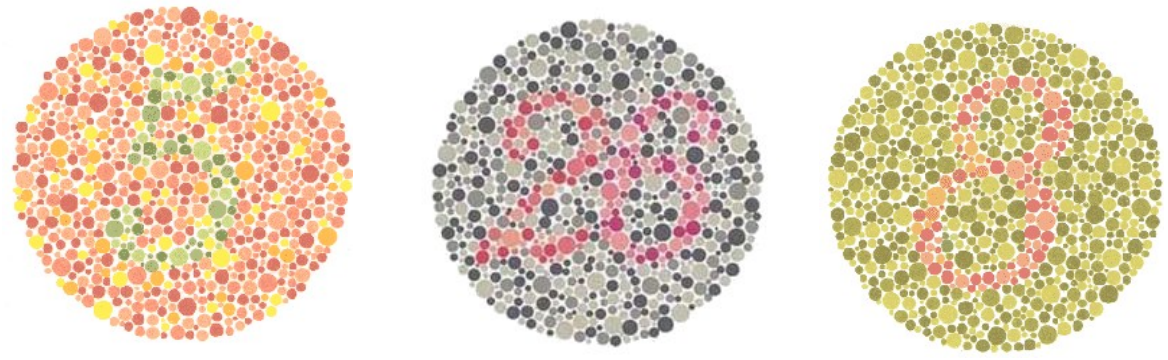


Figure 2. Images accessed from colormax.org/color-blind-test/

The State Trait Inventory of Cognitive and Somatic Anxiety (STICSA; Ree, Colin, MacLeod, French, & Locke, 2000). This assessment consists of 21 items distinguishing

cognitive and somatic symptoms and characteristics of anxiety. Respondents indicate the degree to which each statement is self-descriptive "at this very moment" and "in general," generating both a state and a trait score of anxiety, respectively. Response format options range from 1 to 4: 1=*not at all*; 2=*a little*; 3=*moderately*; 4= *very much so*. Responses are summed across the items. High scores indicate increased levels of state and trait anxiety.

The Ten-Item Personality Inventory (TIPI; Gosling, Rentfrow, Swann, 2013). The TIPI is a brief measure of the "Big Five" personality domains: extraversion, agreeableness, conscientiousness, emotional stability, and openness to experiences. The inventory presents ten pairs of traits (e.g., extraverted, enthusiastic; dependable, self-disciplined). Participants rated the degree to which each pair of traits applies to them: 1=*disagree strongly*; 2=*disagree moderately*; 3=*disagree a little*; 4=*neither disagree or agree*; 5=*agree a little*; 6=*agree moderately*; 7: *agree strongly*. Five items are reversed scored. Each of the five dimension scores reflected an average rating across the two different pairs of items. High scores indicates strength in each personality domain.

Mandala. We acquired the pre-drawn mandala figure used by Curry and Kasser (2005) and van der Vennet and Serice (2012) online. The mandala image was printed in black ink on a 13 x 17-inch white sheet of paper. The diameter of the mandala was approximately 11 inches across. Figure 2 shows a copy of the image.

Momentary Anxiety and Heart Rate Readings. We assessed momentary anxiety by orally asking participants to respond to the question, "On a scale of zero to ten, how anxious do you feel at this very moment in time; zero being not at all anxious, five being somewhat anxious, and ten being very anxious?" After answering this question, we assessed participants' heart rate via a commercial pulse monitoring device that attached to the wrist.

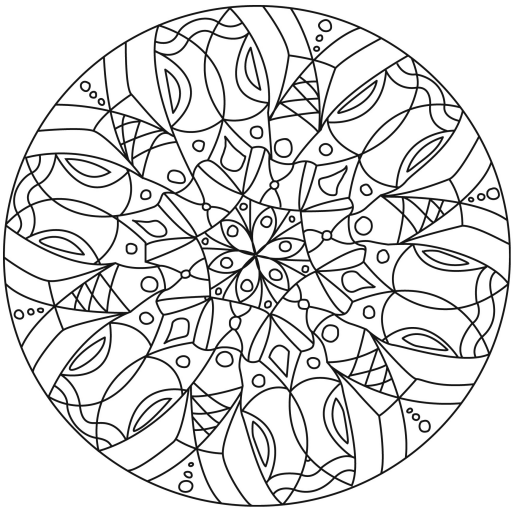


Figure 2. Mandala design taken from www.free-mandala.com

Perception of being a 'good subject' and guessing the experimental hypothesis. We asked participants, "Do you think you were a good research subject today?" using the following scale: 1 = *below average*; 3 = *average*; and 5 = *above average*. We also asked, "What do you think the study was about today? What do you think the hypothesis is?"

Brief Survey of Coloring and Tracing (BSCT). We created a brief survey assessing participants' attitudes and beliefs about the effectiveness of coloring and tracing to lower anxiety for them personally and also for people in general. We also asked about their frequency of coloring. We prefaced items with the following statement: *Some people like to color as a way to relax. Other people don't find coloring very relaxing. People seem to hold very different views about coloring and have different experiences when they color.* 1. *How helpful do you think it is for most people to color when trying to relax or lower anxiety?* 2. *Do you color when you are stressed and want to relax?* ("yes" or "no") 3. *How often do you color within a month's time?* (participants provided a numerical estimate) 4. *For you - yourself, how helpful is coloring when*

you want to relax or lower anxiety (or if you don't regularly color, how helpful do you think *coloring would be to help you relax?* 5. *How helpful do you think it is for most people to trace pictures (not color but trace in pencil or pen the outline of a picture or object) when trying to relax or lower anxiety?* 6. *For you- yourself, how helpful is tracing when you want to relax or lower anxiety (or, if you don't regularly trace, how helpful do you think tracing would be to help you relax)?* Participants responded to questions #1, 4, 5, and 6 using the following scale: 1 = *not at all helpful*; 3 = *somewhat helpful*; 5 = *very helpful*.

Procedure

We recruited students from various undergraduate courses at The Ohio State University at Lima to participate in a study about "heart rate variability" in exchange for a couple of course extra credit points. Students were informed that the study would consist of completing a questionnaire about how often they experience anxiety and answering a very brief personality survey; writing about an upsetting, frightening, or anxiety-provoking event for 4 minutes; engaging in a task for 20 minutes; and then reading a passage from a textbook for another 15 minutes. Participants were informed that their heart rate would be measured at several different time points; however, they would not receive feedback on these measurements. They were asked to bring their cell phones to the study as there might be an opportunity to use their phones during the study. Students over the age of 18 were eligible to participate. Participants signed up for a pre-determined time slot to complete the study. Three experimenters conducted the individual sessions in an interview-like format over the course of three academic semesters. With the exception of the STISCA and TIPI, participants orally responded to questions.

Participants arrived in the 430G lab of Galvin Hall which resembled a small office. They were seated at a desk that was divided in half by a frosted plastic shield so that they could

not view their heart rate readings on the wrist cuff device. All participants were run in the same room to try to keep levels of ambient light, extraneous noise, and room temperature fairly constant. Participants were asked to use the restroom prior to the start of the one-hour long study. Experimenters were trained in study procedures and used a pre-written script in order to standardize how questions were asked and to guide study-related interactions with participants. At the outset of the study, students were re-introduced to the purpose of the study in the following manner: "In this study, we will ask you to complete a couple of short personality questionnaires, write for a few minutes about an event in your life, engage in an activity for 20 minutes, and finally read a short passage from a textbook. We will measure your heart rate at several different time points. We are interested in whether different types of activities affect heart rate." Participants signed a consent form. Experimenters then collected demographic information and began the study proper.

We asked participants about their current anxiety level and measured their heart rate (momentary anxiety time point 1). We administered the STISCA and TIPI. Participants then wrote about an anxiety-provoking event for 4 minutes with the following instructions: "We next want you to think of a past event in your life that was anxiety provoking. It can be any event that you are willing to write about. Please provide as much detail as you are comfortable doing. We want you to pick a past event or something that scared you, made you anxious, or fearful. We will give you four minutes to do this. You can write about the event, who was involved, what you were feeling, doing, or experiencing. Anything you want to tell us. Please continue writing until I tell you to stop." If participants stopped writing during the four minutes, they were asked to continue until the four-minute period ended. At the end of the writing exercise, we reassessed

current anxiety level and remeasured students' heart rate (momentary anxiety time point 2).

Next, we randomly assigned participants to one of four conditions.

Coloring Mandala. "Next, I am going to give you some time to color. Take your time and color on this piece of paper for the next 20 minutes. Feel free to begin anywhere you want. Just keep coloring until I tell you to stop. I'll be quiet for the next 20 minutes and allow you to color."

Trace Mandala. "Next, I am going to give you some time to trace. Take your time and trace this picture for the next 20 minutes. Feel free to begin anywhere you want. Just keep tracing until I tell you to stop. I'll be quiet for the next 20 minutes and allow you to trace." Participants were instructed to use a black ink pen provided to them.

Waiting Room (control). "Next, I am going to give you some free time. You can do whatever you want for the next 20 minutes. Feel free to use your phone, look at a magazine, or just look around the room. I will let you know when we are ready for the next part of the study. I'll be quiet for the next 20 minutes and allow you do use your phone or look at a magazine." Four magazines were given for optional reading: National Geographic, 2015; People Magazine, 2019; Time Magazine, 2013; Sports Illustrated, 2002.

Midway through and at the end of the 20-minute intervention, we reassessed current anxiety and remeasured students' heart rate (momentary anxiety time points 3 and 4). We then instructed participants to read for 15 minutes a selected piece from an introductory geology textbook, *The Earth: An Introduction to Physical Geology* (Tarbuck et al, 1992). We selected this particular narrative because we thought it would be a factual presentation of information that would not likely create an emotional response. We gave the following instructions: "Next, we want you to read for a little bit. Here is a passage from a textbook. You will read for about 15

minutes. Read the passage as you would read an assignment in one of your college courses. That is, try to understand, as best you can, the material in the passage. I'll tell you when to stop."

At the end of the fifteen minutes, we administered the final assessment of anxiety and heart rate (momentary anxiety time point 5). Participants rated how good of a subject they thought they were, if they could guess the study hypothesis, and then completed the survey items about coloring and tracing (BSCT).

Finally, to ensure that anxiety-inducing exercise did not leave a lasting negative impact, we administered a one-minute visualization exercise designed to create pleasant feelings. These were the instructions: "Now that the study is over, we want to ensure that you are feeling ok, safe, and secure. Let's take a minute and have you think of something pleasant. It can be anything you want to think about. Take a moment now and just think of some time, event, or situation where you felt really good, happy, and full of life. As an example, perhaps you would like to think about how you felt after doing well on an exam or after completing an assignment and knowing that you did your best; or, perhaps you'd like to think about doing well at a performance or succeeding in a game; or, maybe it would be nice to just think about an enjoyable time when you were with family and friends. I'm going to be quiet for a little bit and let you think of a time where you felt wonderful, happy, safe, and full of life. Go ahead and do this now." Students were then thanked for participating and offered the option of taking a contact card for free counseling services at our university, should they feel any need to do so. Figure 3 shows a flowchart of when we assessed anxiety.

Procedural Flowchart

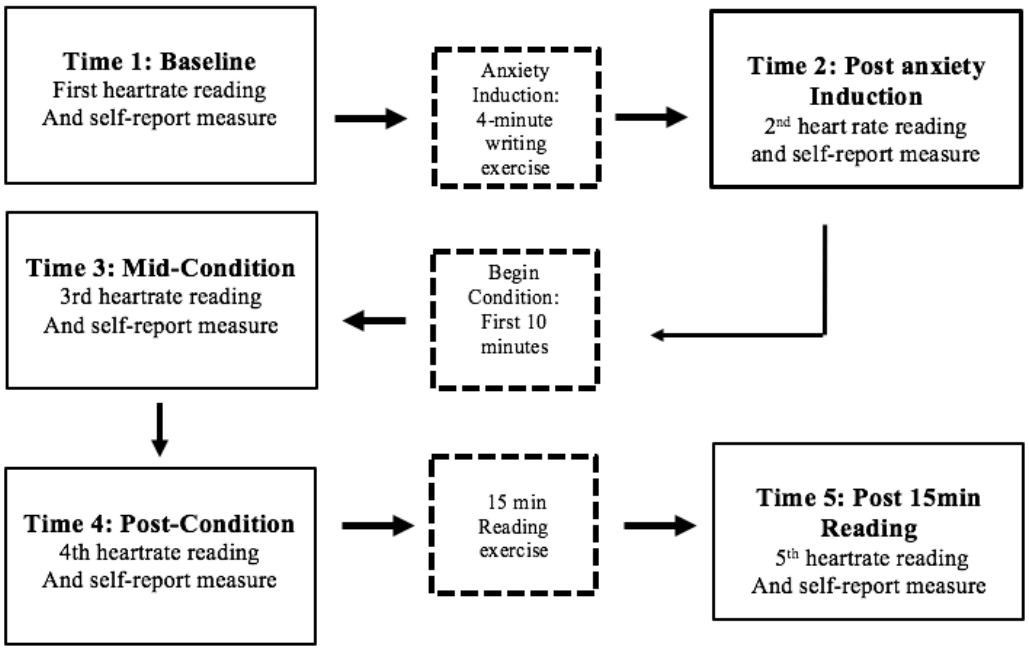


Figure 3. Procedural flowchart of the five assessment time points.

Predictions

Pre-existing traits and personality. We predicted that average scores of students within each of our conditions would be similar across our measures of pre-existing trait and state anxiety and personality due to random assignment. Similarly, we predicted that average momentary-anxiety ratings would be similar across our four groups of students at baseline.

Effect of an Interaction of Time and Condition. If coloring the mandala is uniquely associated with reducing anxiety, then students in the Color Mandala condition should show the greatest reduction in anxiety between the end of the anxiety-inducing exercise (time point 2) and while coloring (time point 3) and after coloring (time point 4), relative to other conditions. If

coloring it not important but interacting with the mandala is, then students in the Color Mandala and Trace Mandala conditions should show the greatest reduction in anxiety compared to the Free Color and Waiting Room conditions. If coloring is most important, then students in the Color Mandala and Free Color condition should show the greatest reduction in anxiety relative to the Trace Mandala and Waiting Room conditions.

Effect of Time. We predict that momentary anxiety scores will be higher at the end of the anxiety-inducing exercise (time point 2) than at baseline (time point 1) for all conditions. This would simply show that the writing exercise worked as intended. We predict that momentary anxiety at the end of the 20-minute intervention (i.e., time point 4) will be lower than ratings taken after the writing exercise (i.e., at time point 2) for all conditions because anxiety tends to dissipate over time. Assuming that 10 minutes is sufficient to reduce anxiety, we expect to find a reduction in anxiety from time point 2 (end of anxiety-inducing exercise) to time point 3 (mid-way through the intervention). If, on the other hand, a full 20 minutes is needed in order to reduce anxiety, then comparisons between time points 2 and 3 should not differ but time points 2 and 4 should. If any reduction in anxiety persists beyond the immediate end of the intervention, then momentary anxiety ratings at time points 4 (end of intervention) and 5 (after a 15 minute delay) should be the same. We were curious to learn if students leaving the study would report higher or lower momentary anxiety ratings relative to when they entered the study (comparison of time points 5 vs. 1). If only the passage of time is most important to lower anxiety after the writing exercise, then we would expect to find no differences between our four conditions. And, we should find that anxiety measurements decrease for all students from time point 2 (end of the anxiety-inducing writing) to subsequent time points (i.e., time points 3, 4, and 5 should be progressively lower than time point 2).

Effect of Condition. We specifically do not predict condition differences on our pre-existing measures of anxiety (STICSA) and personality (TIPI) or anxiety readings obtained at time point 1. We also predict no condition differences at time 2 because the writing exercise occurs before our condition-related intervention. Nor do we expect to find a condition-related effect of averaged anxiety ratings across all five time points.

Brief Survey of Coloring and Tracing. Based on our own intuition, we predict that more female participants, relative to males, would report coloring to relax when they are stressed, and they would also report coloring on a more frequent basis.

Participants

A total of 129 undergraduate students at The Ohio State University, Lima, enrolled in the study in exchange for course extra credit. Eight students failed our color blind screening test and were subsequently eliminated from the study. Final data analyses were based on N=121 students (n_{female}=70; n_{male}=51). Within each condition, the number of participants and gender breakdown was as follows: Color Mandala=30 (n_{female}=16; n_{male}=14); Free Color=29 (n_{female}=17; n_{male}=12); Trace Mandala=30 (n_{female}=18; n_{male}=12); and, Waiting Room=32 (n_{female}=19; n_{male}=13). The mean age of the sample was M=20.77 (SD=6.06). The ethnicity of our sample was broken down across the following categories: 83% Caucasian; 78% African American; 1.7% Asian; 1.7% Hispanic or Latino; and, 5.8% biracial or other. No participant suspected that our study specifically focused on the mandala.

Results

Preliminary analyses. Results from a one way analysis of variance (ANOVA) indicated that the average age of students did not differ by condition assignment, $F(3,117)=.71$, $p=.55$.

Results of a Chi-square test showed that the proportion of female to male students within each of our conditions did not differ statistically, $X^2(3)=.34$, $p=.95$.

The vast majority of the primary data analyses did not include gender as an independent variable because doing so would result in too few participants per cell. For example, there were only 12 male students within both the Free Color and Trace Mandala conditions and a minimum of at least 20 is commonly recommended (Simmons, Nelson, & Simonsohn, 2011). We did examine potential gender differences in exploring student attitudes across items on our BSCT, in order to test our a priori predictions related to this scale.

STICSA/TIPI. We conducted a multivariate analysis of variance (MANOVA) to examine whether students within each of our four conditions differed in state and trait anxiety as measured by the STICSA or across the 5 personality dimensions as measured by the TIPI. Multivariate results were not significant, Pillai's trace $F(21, 339)=.64$, $p=.89$. None of the 7 univariate tests were significant, all Fs$(3,117)<1.03$, all ps$>.38$.

Tests of assumptions, outliers, and data concerns associated with our momentary anxiety assessments and heart rate readings. Across all conditions and the five different time points where we collected self-reported anxiety ratings, we found 5 responses that were more than 1.5 times the interquartile range (IQR) indicating that these data points were outliers. We double checked participants' responses and data entry to make sure these data points were correctly entered. Students tended to report low levels of anxiety producing a positively skewed distribution across the majority of time points, with the exception of time 2 (following the anxiety inducing exercise). Across time points 1, 3, 4, and 5, between 25% and 35% of participants reported having "0" anxiety. Tests of normality, homogeneity of variances, equality of variances, and sphericity were all significant indicating that we violated these assumptions.

Removing outliers and attempts to transform the data did not appreciably resolve these concerns. Heart rate readings were mostly normally distributed but they contained 11 outliers based on the IQR. Tests of the assumption of equality of covariances and sphericity were significant.

Primary analyses.

Self-reported momentary anxiety levels. We conducted a two way mixed ANOVA to examine whether the pattern of self-reported anxiety levels differed by condition. Because of the violation of sphericity, we applied the Huynh-Feldt correction that multiplied our degrees of freedom by epsilon, $\varepsilon = 0.838$. There was not a significant interaction between the intervention (i.e., 4 conditions) and time on self-reported anxiety levels, $F(10.06, 392.41)=1.13$, $p=.33$. The main effect of condition was not significant, $F(3, 117)=2.08$, $p=.11$. As predicted, the main effect of time was significant, $F(3.35, 392.41)=72.14$, $p<.001$; partial eta squared, $\eta^2=.38$. Bonferroni post hoc pairwise comparison tests revealed significant changes in self-reported anxiety across the following time points: 1 vs. 2, 3, 4, 5; 2 vs. 3, 4, 5; 3 vs. 4. Figure 1 shows the pattern of self-reported anxiety levels by condition across time.

Heart rate readings. We conducted a separate two way mixed ANOVA using pulse rate as our dependent measure which was measured at 5 different time points. Once again, condition was our between-subjects factor and time was our within-subjects factor. Because of the violation of sphericity, we adjusted the degrees of freedom using the Huynh-Feldt correction, $\varepsilon = 0.968$). There was not a significant interaction between the 4 conditions and time on pulse rate, $F(11.61, 449.05)=0.65$, $p=.79$. Similar to self-reported anxiety, the main effect of condition on heart rate, collapsed across time, was not significant, $F(3, 116)=0.23$, $p=.88$. The main effect of

time nearly reached but ultimately failed to reach significance, $F(3.87, 449.05)=2.26$, $p=.06$. Figure 2 shows the pattern of heart rate readings by condition across time.

Self-assessment of being a 'good subject'. Next, we conducted a one-way ANOVA to explore students' self-reported assessment of whether they thought they "were a good research subject today." As expected, means (overall $M=3.45$; $SD=.82$) did not differ by condition, $F(3, 117)=1.25$, $p=.29$.

BSCT. Finally, we examined responses to items on the BSCT scale, first by condition and then later by gender. Because the response format for the question regarding color use ("Do you use coloring when you are stressed and want to relax?") was categorical (i.e., "yes" or "no"), we analyzed responses to this item using the Chi-square test. The proportion of yes [range= 5/29 (17.2%) to 12/30 (40.0%)] and no [range = 18/30 (60.0% to 24/29 (82.8%)] responses did not statistically differ by condition, $X^2(3)=3.91$, $p=.27$.

For the remaining five questions, we conducted a MANOVA by condition. The multivariate effect was not significant, Pillai's Trace $F(15,345)=1.43$, $p=.10$. All univariate F tests were also non-significant with the exception of the last question, 'how helpful is tracing to you?' A post hoc test indicated that students in the Color Mandala ($M=2.87$; $SD=1.14$) condition rated this item higher than students in the Waiting Room ($M=1.94$; $SD=1.24$) condition. Overall mean scores across individual items on our BSCT and univariate test statistics by condition are listed in table 1.

Because we specifically predicted that our female students would report engaging in coloring to reduce stress and would also color more regularly than our male participants, we duplicated both the Chi-square and MANOVA tests described above, substituting gender for condition as our independent variable. A greater proportion of female students [30/70 (42.3%)]

than male students [7/51 (13.7%)] reported that they color when stressed, X^2=11.79, p=.001. Results from the MANOVA showed a non-significant multivariate effect, Pillai's Trace $F(5,115)=1.01$, $p=.41$. However, given our a priori prediction, we examined the univariate F tests with respect to gender with an eye toward color frequency. All tests were non-significant [Fs(1,119)<1.02, ps>.31] with the exception of how often female and male students color per month, $F(1,119)=4.45$, $p=.04$. Overall mean scores across the individual items on our BSCT and univariate test statistics by gender are listed in table 2.

Discussion

Contrary to Curry and Kasser (2005) and van der Vennet and Serice (2012), we did not find any unique condition-related effect of anxiety reduction associated with coloring a mandala. Indeed, all four of our conditions showed the same pattern of results across our self-reported momentary anxiety ratings. As you can see in Figure 3, self-reported anxiety ratings significantly change across time. The pattern indicates that participants felt an increase of anxiety after the four-minute writing exercise as we intended. Then, a significant decrease was shown within the first ten minutes of each condition, and a continued reduction of anxiety at the end of each condition. This pattern of evidence indicates that only ten-minutes of coloring, tracing, or waiting was necessary to observe a significant decrease in anxiety. Our findings have implications for future research in that coloring effects can be observed after only 10 minutes versus a 20-minute period which has typically be used in prior work. Still, a greater reduction in anxiety was evident at the end of the 20-minute period (time points 3 and 4). Ratings of anxiety did not continue to decrease following the end of the intervention activity. Reports after the 15-minute delay were not statistically different from either time point associated with the intervention (i.e., time point 3 and time point 4 did not differ from time point 5). Perhaps this

was due to the fact that by time point 4, anxiety ratings were already quite low and there wasn't much room to go any lower.

Because we found no effect associated with condition, our results do not offer support for the claim that coloring a mandala specifically, or even coloring in general, produces a greater reduction in anxiety relative to tracing a mandala or simply waiting for a 20-minute period of time. Our results were similar to those found by Curry and Kasser (2005) and van der Vennet and Serice (2012) in that coloring a mandala was associated with a reduction in anxiety and that anxiety levels at time 3 (after coloring the mandala) were lower than at time 1 (baseline). However, unlike their work we observed the same pattern across all of our conditions. In fact, participants in our Free Color and Waiting Room (control) conditions showed a similar decrease in anxiety to that observed from students in the coloring and tracing conditions. Based on our findings related to our control condition, it appears that simply waiting for 20 minutes while reading a magazine or using one's phone, can be just as effective to reduce anxiety as creative art activities such as coloring or tracing a mandala. Consistent with our findings, Duong, Stargell, and Mauk (2018) compared coloring a mandala with free coloring and found no difference in terms of reducing anxiety among masters level counseling students.

Heart rate measurements did not differ by condition, time, or interaction of condition by time. The pattern of heart rate readings was not the same as we observed with self-reported anxiety. As one example, the pattern of heart rate readings for students in the Free Color condition showed a *decrease* in heart rate after the writing exercise compared to baseline (see Figure 5). This does not make sense and is opposite of what would be expected based on our design. While other researchers claim that heart rate can be used as a marker of anxiety and relaxation (e.g., DeLue, 1999), we wonder how reliable of a measure it is for state anxiety.

Mauss and colleagues (2004) found that self-reported anxiety during a speech task correlated with *perceptions* of bodily changes (e.g., higher heart rate, sweaty palms) but was unrelated to actual physiological measurements. Trotman (2019) similarly found that perceived heart rate correlated more strongly with self-reported anxiety than actual heart rate.

As predicted, students within each of our conditions averaged similar scores on the STICSA and TIPI, and gave similar self-reported anxiety readings at baseline. Participants within our conditions rated themselves similarly in terms of being a good research subject. Ratings across our BSCT items did not differ by condition with the exception of students in our Color Mandala condition rated the tracing as being more effective to reduce anxiety than did students in our Waiting Room condition. This finding was unexpected. It is unclear what this finding means or whether this just a statistical anomaly, perhaps due to our relatively small sample size.

As we suspected, a higher percentage of female participants reported using coloring more often than male participants as a way to relax. Female participants also reported coloring on a more frequent basis than male participants. We did not find gender differences in attitude about the effectiveness of coloring or tracing to reduce anxiety.

Limitations and Future Directions

Our primary results are tentative because we violated assumptions associated with statistical tests. Another limitation was our small sample size. While the proportion of females to males per condition did not statistically differ, we were unable to specifically analyze for gender-related effects within our conditions due to our sample size. We had approximately 30 students per condition and breaking each condition down by gender would result in the number of students within each cell falling below 20, a minimum value often recommended by

statisticians (e.g., Simmons, Nelson, Simonsohn, 2011). A much larger sample would permit researchers to examine the role of gender within conditions. In addition, with a larger sample, researchers could break down the sample into individuals high or low in state and trait anxiety (e.g., as measured by the STICSA) or divide people on the basis of specific personality traits (e.g., as measured by the TIPI). Future work with a larger sample might replicate our findings regarding items on the BSCT. Future studies may consider distributing the BSCT before and after introducing the condition exercises. This could reveal if pre-existing beliefs about the coloring and tracing have an effect on participants' experience of anxiety while coloring or tracing.

In conclusion, our findings question the claim that coloring a mandala is uniquely associated with anxiety reduction.

References

American Psychological Association. (2020). Anxiety. Retrieved from https://www.apa.org/topics/anxiety/

Abbing, A., Ponstein, A., van Hooren, S., deSonneville, L., Swaab H., Baars, E. (2018) The effectiveness of art therapy for anxiety in adults: A systematic review of randomized and non-randomized trials. PLoS ONE 13(12):e0208716. https://doi.org/10.1371/journal.pone.0208716

Brauen, M. (2009). *Mandala: sacred circle in Tibetan Buddhism*. New York: Rubin Museum of Art.

Chilton, G. (2013). Art Therapy and Flow: A Review of the Literature and Applications. *Journal of the American Art Therapy Association, (30)2,* 64-7. doi: 10.1080/07421656.2013.787211

Color Blind Test: Test Color Vision by Ishihara Test for Colorblindness. (n.d.). Retrieved from https://colormax.org/color-blind-test/

Curry, N. A., & Kasser, T. (2005). Can Coloring Mandalas Reduce Anxiety? *Art Therapy*, *22*(2), 81–85. doi: 10.1080/07421656.2005.10129441

DeLue, C. (1999). Physiological effects of creating mandalas. In C. Malchiodi (Ed.), *Medical Art Therapy with Children* (pp. 33-49). Jessica Kingsley Publishers. doi.org/10.1017/s136064170027233x

Duong, K., Stargell, N.A., & Mauk, G.W. (2018). Effectiveness of coloring mandala designs to reduce anxiety in graduate counseling students. *Journal of Creativity in Mental Health, 13*(3), 318-330. doi: 10.1080/15401383.2018.1437001

Gosling, S.D., Rentfrow, P.J., & Swann, W.B., Jr. (2003). A Very Brief Measure of the Big Five Personality Domains. *Journal of Research in Personality, 37,* 504-528.

Harvard Medical School, 2007. National Comorbidity Survey (NCS). (2017, August 21). Retrieved from https://www.hcp.med.harvard.edu/ncs/index.php. Data Table 2: 12-month prevalence DSM-IV/WMH-CIDI disorders by sex and cohort.

Ishihara, S. (1972). *Tests for Colorblindness*. Tokyo, Japan: Kanehara Shuppan, Co. LTD.

Jung, C. G. (1973). *Mandala symbolism*. Princeton, NJ: Princeton University Press.

Mauss, I., Wilhelm, F., & Gross, J. (2004). Is there less to social anxiety than meets the eye? Emotion experience, expression, and bodily responding. *Cognition & Emotion*, *18*(5), 631–642. doi: 10.1080/02699930341000112

Ortiz, A., & Grof, P. (2016). Electronic monitoring of self-reported mood: the return of the subjective?. *International journal of bipolar disorders*, *4*(1), 28. https://doi.org/10.1186/s40345-016-0069-x

Rajendran, N., Mitra, T. P., Shahrestani, S., & Coggins, A. (2020). Randomized Controlled Trial of Adult Therapeutic Coloring for the Management of Significant Anxiety in the Emergency Department. *Academic Emergency Medicine*, *27*(2), 92–99. doi: 10.1111/acem.13838

Ree, M. J., French, D., Macleod, C., & Locke, V. (2008). Distinguishing Cognitive and Somatic Dimensions of State and Trait Anxiety: Development and Validation of the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA). *Behavioural and Cognitive Psychotherapy*, *36*(03). doi: 10.1017/s1352465808004232

Sandmire, D. A., Gorham, S. R., Rankin, N. E., & Grimm, D. R. (2012). The Influence of Art

Making on Anxiety: A Pilot Study. *Art Therapy*, *29*(2), 68–73. doi: 10.1080/07421656.2012.683748

Social Anxiety Disorder. (n.d.). Retrieved March 26, 2020, from https://www.nimh.nih.gov/health/statistics/social-anxiety-disorder.shtml

Spruill, T. M., Pickering, T. G., Schwartz, J. E., Mostofsky, E., Ogedegbe, G., Clemow, L., & Gerin, W. (2007). The impact of perceived hypertension status on anxiety and the white coat effect. Annals of Behavioral Medicine, 34(1), 1–9. https://doi-org.proxy.lib.ohio-state.edu/10.1007/BF02879915

Sue, Sue, Sue & Sue (2016). Understanding Abnormal Behavior (11th Ed.). Wadsworth, Cengage Learning.

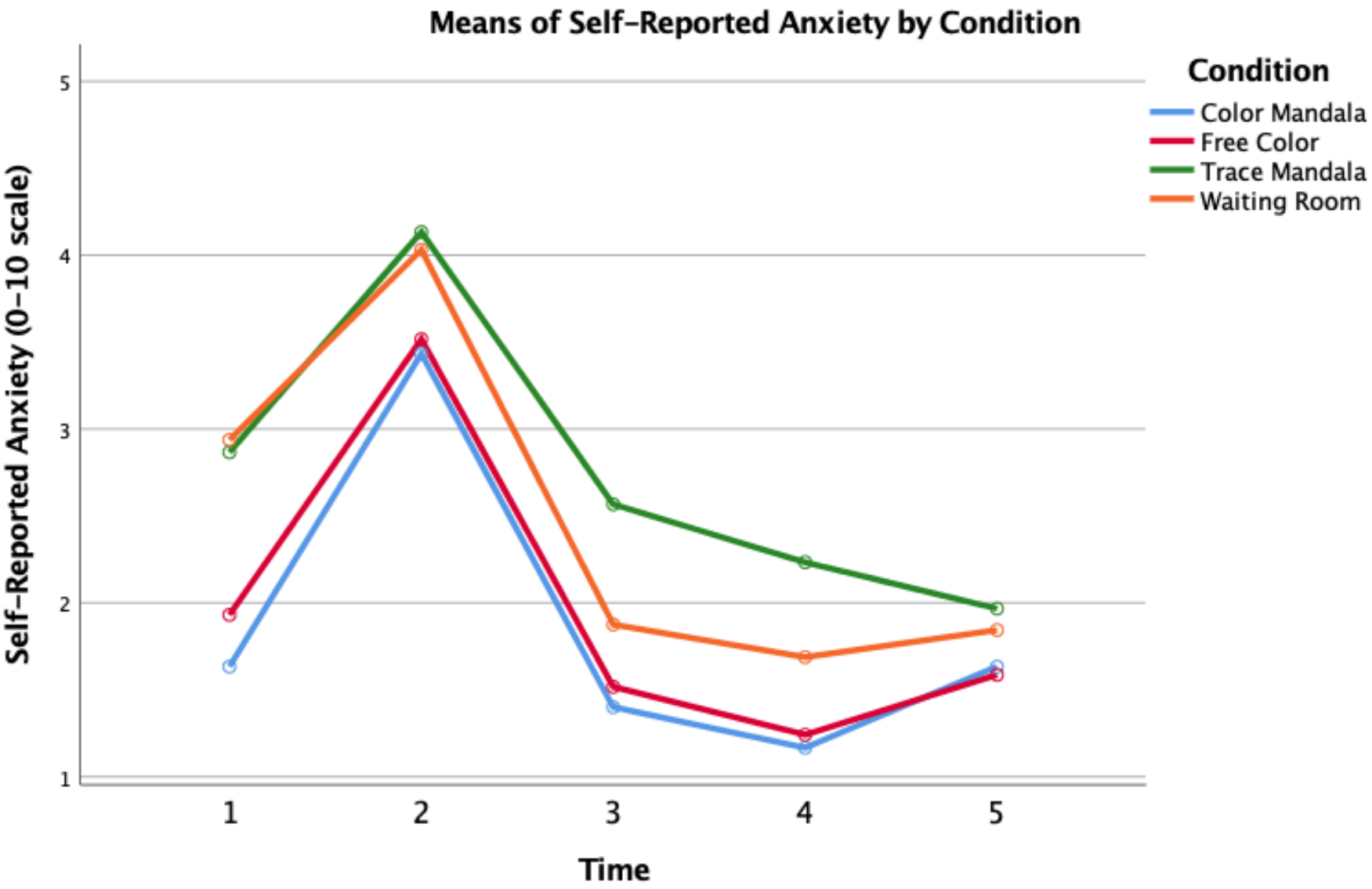
Tarbuck, E. J., Lutgens, F. K. (1992). Matter and Minerals. In R. A. McConnin (Eds.) *The Earth: An Introduction to Physical Geology* (pp.31-52). Macmillan Publishing Company.

Trotman, G. P., Jet J. C. S. Veldhuijzen Van Zanten, Davies, J., Möller, C., Ginty, A. T., & Williams, S. E. (2019). Associations between heart rate, perceived heart rate, and anxiety during acute psychological stress. *Anxiety, Stress, & Coping*, *32*(6), 711–727. doi: 10.1080/10615806.2019.1648794

Vennet, R. V. D., & Serice, S. (2012). Can Coloring Mandalas Reduce Anxiety? A Replication Study. *Art Therapy*, *29*(2), 87–92. doi: 10.1080/07421656.2012.680047

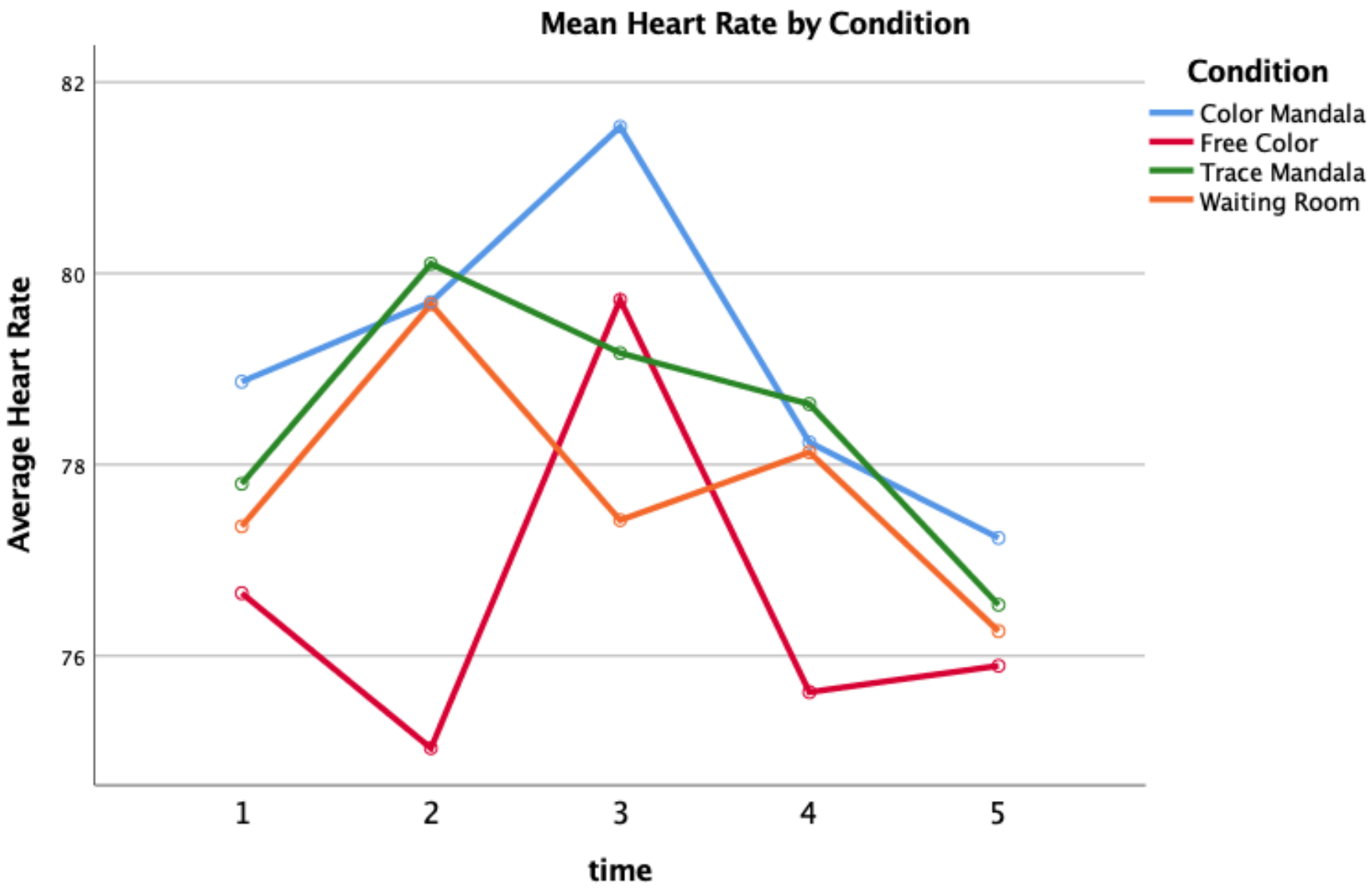
Weidman, A.C., Steckler, C.M., & Tracy, J.L. (2017). The jingle and jangle of emotion assessment: imprecise measurement, casual scale usage, and conceptual fuzziness in emotion research. *Emotion, 17*(2), 267-295. doi: 10.1037/t03592-0000

Figure 4. Main effect for self-reported anxiety across time.



Beginning of study Condition activity (1/2 way) End of study
Post anxiety writing Condition activity (end)

Figure 5. Average heart rate by condition across time.



Beginning of study Condition activity (1/2 way) End of study
Post anxiety writing Condition activity (end)

Table 1: Results from the MANOVA and Chi-Square tests on BSCT items.

Question	*M*	*SD*	*F*	*p*
1. How helpful do you think it is for most people to color when trying to relax or lower anxiety?	3.92	.69	.44	.73
3. How often do you color within a month's time?	2.69	6.90	1.37	.25
4. For you, yourself, how helpful is coloring when you want to relax or lower anxiety?	3.52	1.27	1.56	.20
5. How helpful do you think it is for most people to trace pictures when you want to relax or lower anxiety?	2.90	1.08	.49	.69
6. For you-yourself, how helpful is tracing when you want to relax or lower anxiety?	2.55	1.32	3.50	.02*

	Yes	No	X^2	*p*
2. Do you color when you are stressed and want to relax?	37/121 (30.6%)	84/121 (69.4%)	3.91	.27

Notes: *M* and *SD* statistics reflect overall sample *N*=121. F and p statistics generated from univariate tests on the main effect of condition with (3,117) degrees of freedom. The degrees of freedom associated with the Chi-square test was (3).
*Post hoc tests indicated that average ratings statistically differed between our Color Mandala (M=2.87; SD=1.14) and Waiting Room (M=1.94; SD=1.24) on item #6.

Table 2: Results from the MANOVA and Chi-Square tests on BSCT items by gender.

Question	*Females* *M (SD)*	*Males* *M (SD)*	*F*	*p*
1. How helpful do you think it is for most people to color when trying to relax or lower anxiety?	3.97 (.76)	3.84 (.58)	1.02	.31
3. How often do you color within a month's time?	3.80 (8.04)	1.16 (4.56)	4.45	.04*
4. For you- yourself, how helpful is coloring… when you want to relax or lower anxiety?	3.60 (1.29)	3.41 (1.24)	.65	.42
5. How helpful do you think it is for most people to trace picture when you want to relax or lower anxiety?	2.89 (1.19)	2.92 (.93)	.03	.86
6. For you, yourself how helpful is tracing… when you want to relax or lower anxiety?	2.51 (1.34)	2.61 (1.30)	.15	.70

	Female "yes"	Male "yes"	X^2	*P*
2. Do you color when you are stressed and want to relax?	7/51 (13.7%)	30/70 (42.9%)	11.80	.001**

Notes: *M* and *SD* statistics reflect overall sample *N*=121. F and p statistics generated from univariate tests on the main effect of gender with (1,119) degrees of freedom. The degrees of freedom associated with the Chi-square test was (1).

Footnotes

Footnote 1. The first plate shows a “5”. Most colorblind people will have difficulty identifying the number. The second place displays “26” and those who are red colorblind may only see a “6” while those who experience green colorblindness may only be able to identify a “2”. The third plate shows an “8”. If a “3” is identified, the reader is most likely red-green colorblind. Those who are totally colorblind will not be able to identify any number in this plate.